STEWARDSHIP of a PRICELESS RESOURCE

July 06, 2008

City of Bluffton, South Carolina

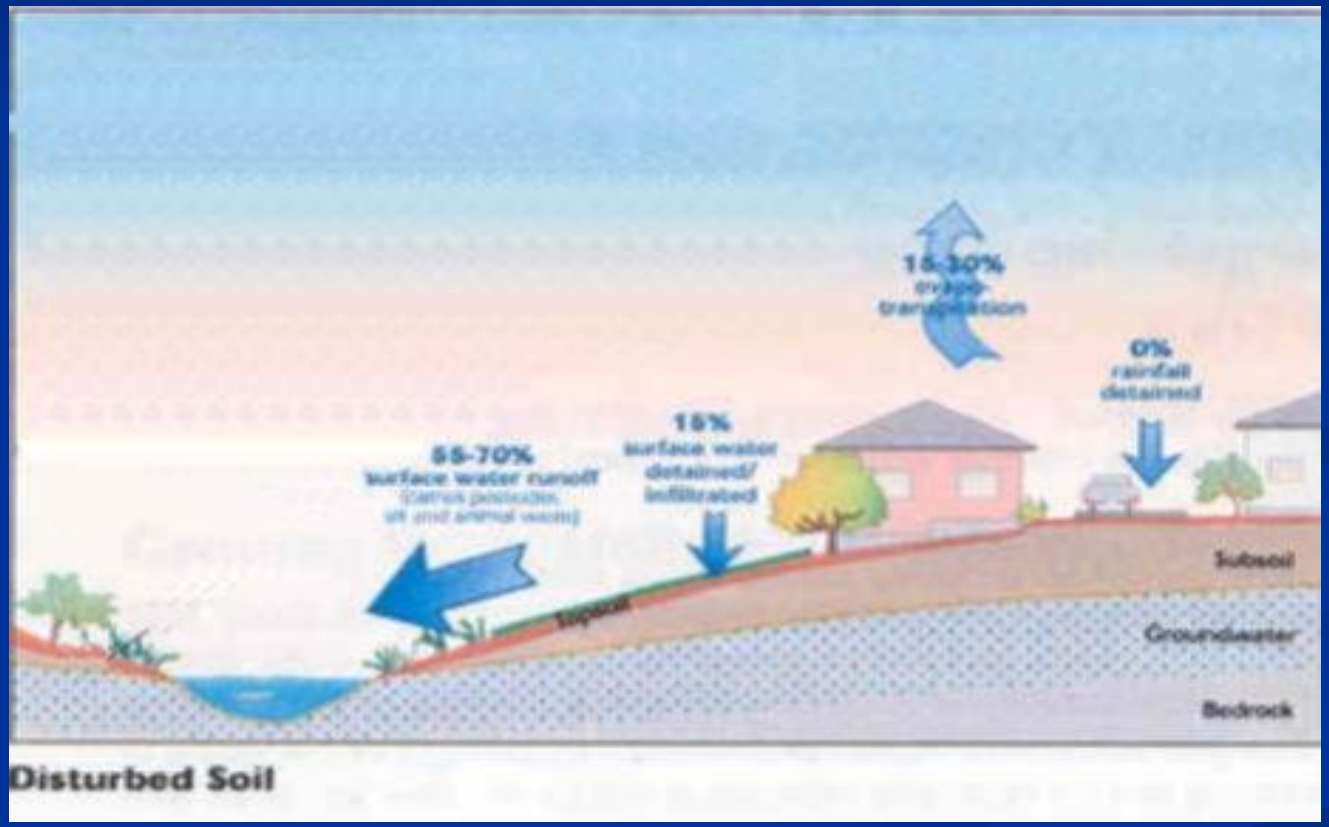
”We shall have no better conditions in the future if we are satisfied with all those which we have at the present” –

Thomas Edison

The Most Precious Resource

- Fresh Water
  - free from containments or pollution which would prevent human consumption and/or use.

Natural Hydrological Cycle



Water Facts

- Water on Earth: 97% salt; remaining 3% fresh; 2/3 of this is frozen
- Frozen water is 9% lighter than liquid
- 1 gal = 8.33 lbs.
- Salt water (un-drinkable) is 0.0001% salt
- 66% human body is water (about 10 gals.)
- 75% of the brain is water
- A person can live 30 days without food but only 7 days without water
- Water leaves the stomach within 5 minutes after consumption

A Definition of Sustainability

- the behavior of meeting the needs of our generation without negatively impacting or preventing future generations from meeting their own needs
- pertains to all aspects of your world including social, economic and environmental
- our discussion will focus on the relevance of sustainability to water

The Foundations of Sustainability

- **stewardship is the foundation of true sustainable behavior**
- What is **stewardship?**
  - The careful and responsible management of something owned by another being entrusted into one's care.
- sustainability is impossible without having the mindset and heart of a steward.

The 'True Cost' of water

- Consider the energy consumption used to deliver water to your tap
  - 37.5 gals per kWh
- Consider the water consumption to sustain our lifestyle
  - 150 gpd US

Energy – Water Relationship

- 47.5 gallons water to generate 1 kW electricity
- A 60 W light bulb uses 30 gallons in 12 hrs. or 2.5 gallons per hour
- The Average Atlantan Home uses:
  - 28 kW h per day
  - 980 gallons per hour
  - 23,520 gallons per day

- Virginia Water Resources Research Center, April 2008 for fossil fuel fired thermoelectric power
- Electricity production and consumption are most commonly measured in kilowatt-hours (kWh). A kilowatt-hour means one kilowatt (1,000 watts) of electricity produced or consumed for one hour. One 50-watt light bulb left on for 20 hours consumes one kilowatt-hour of electricity (50 watts x 20 hours = 1,000 watt-hours = 1 kilowatt-hour).

Water consumption for different types of energy production.

Power Generation Technologies	Efficiency (L/1000 KWh)
Hydroelectric	260
Geothermal	1680
Solar thermal	2970–3500
Fossil fuel thermoelectric	14 200–28 400
Nuclear	31 000–74 900

Fuel Source	Efficiency (liters per 1000 kilowatt-hours)
Natural gas	38
Synfuel: coal gasification	144–340
Tar sands	190–490
Oil shale	260–640
Synfuel: Fisher-Tropsch	530–775
Coal	530–2100
Hydrogen	1850–3100
Liquid natural gas	1875
Petroleum/oil-electric sector	15 500–31 200
Fuel ethanol	32 400–375 900
Biodiesel	180 900–969 000

Does Ethanol Impact our Water Supply?

- An acre of corn consumes 4000 gallons of fresh water per day.

"To waste, to destroy, our natural resources, to skin and exhaust the land instead of using it so as to increase its usefulness, will result in undermining in the days of our children the very prosperity which we ought by right to hand down to them amplified and developed" ~

Theodore Roosevelt

Message to Congress, December 3, 1907

"You can't escape the responsibility of tomorrow by evading it today" –

Abraham Lincoln

Unsustainable (foolish) Consumption of Drinking Water

- pressure washing buildings and hard-scapes
- irrigating landscapes
- flushing toilets
- public water fountains and water features
- lumber milling
- pulp and paper manufacturing
- ornamental plant nursery irrigation
- fire suppression in buildings

What Is the Global Water Situation?

- The consumption of water doubles every twenty years – more than twice the rate of the increase in human population
- More than 2 billion people in the world do not have a safe supply of fresh water.
- At least 400 million people live in regions with severe water shortages. Walking 3 hrs. per day to fetch water is not uncommon.

American Water Use

- Americans use 150 gpd
- Europeans use 53 gpd
- Africans use 6 gpd

Our Nation

- Several portions of the country experience culturally or socially induced drought – especially the Southwest (Arizona, New Mexico and California) and portions of the Southeast (Florida and Georgia)
- Several aquifers, such as Ogallala and Florida, are being 'mined' and recovery is doubtful
- 21 percent of agricultural irrigation is achieved by pumping groundwater at rates that exceed recharge rates
- Aquifer depletion is widespread as indicated by well depth
  - Tucson: 490 down to 1500 ft
  - Phoenix: down 390 ft.
  - Albuquerque: down 66 ft.
- Non Point Source Pollution is the major problem with surface water supply

Where Does all of Our Water Go?
In Gallons

- Amount of water required to grow one day's food for a typical family in USA is 6,800
- Refine one barrel of oil = 1,850
- Manufacture one average size car = 39,000
- Manufacture four tires = 2072
- Grow one orange = 132
- Produce one egg = 120
- One can of fruit or vegetables = 9.3
- Average person brushing teeth = 2
- One bottle beer = 1

The Southeast U.S.A.

- Population growth and suburban sprawl in the metropolitan areas of Atlanta, Orlando, Miami and Savannah has stressed water supplies
- Saltwater intrusion is becoming a problem in the coastal areas impacting the Florida Aquifer as extraction surpasses 1.7 million gallons per minute
- Industrial agriculture in the Coastal Plain mines the Florida Aquifer

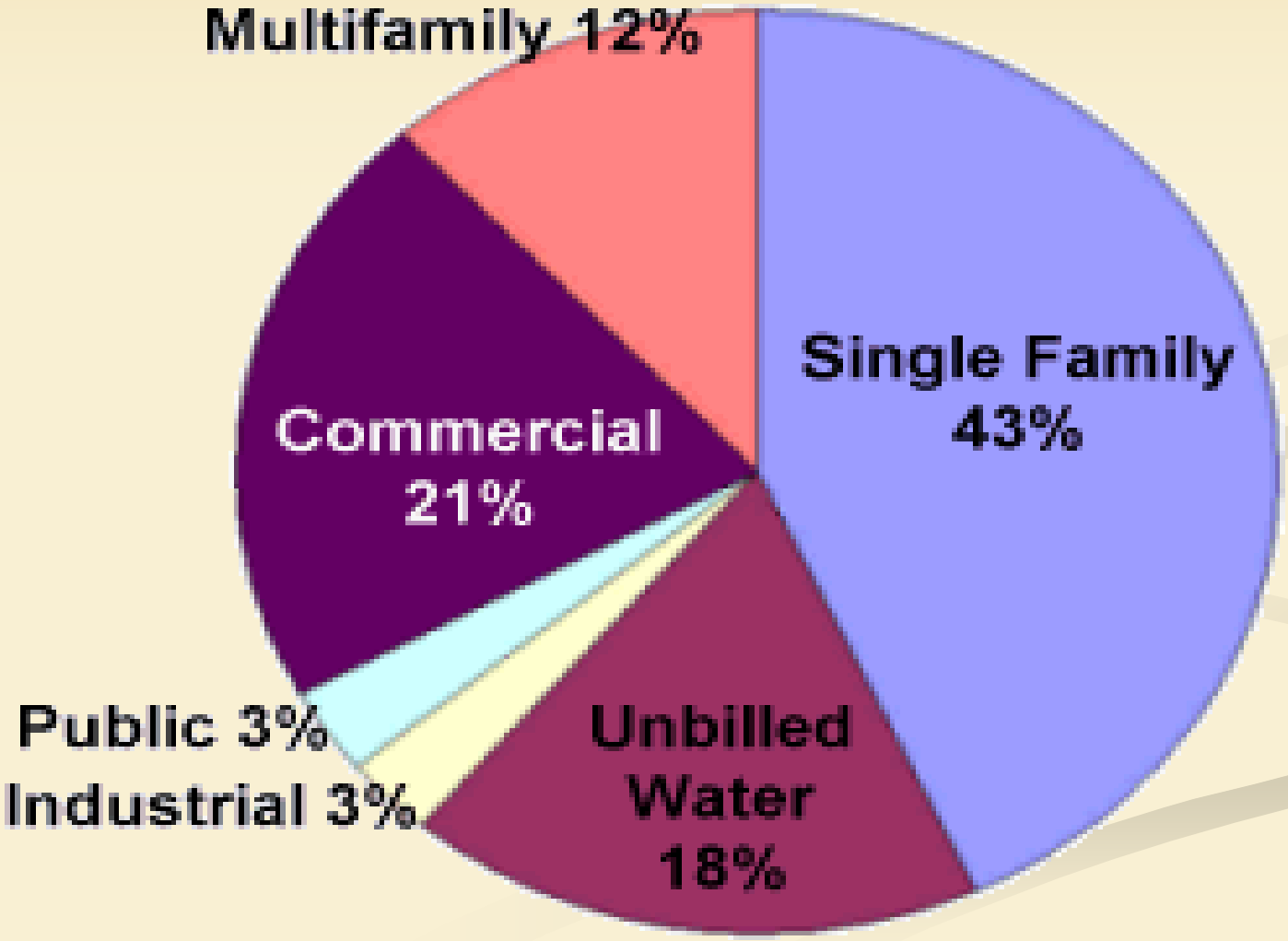
Georgia

- Two distinct water use patterns
  - North Georgia is a developed urban/suburban society and using water primarily for sanitation, industry and urban agriculture (landscaping)
    - Primary source: manmade reservoirs (Lanier, Alatoona and Hartwell) and other surface water (rivers)
  - South Georgia is primarily rural and an agricultural society using water primarily for agriculture
    - Primary source: Florida Aquifer

Metro Atlanta

- We depend primarily on surface water
- By 2030, the increasing population and it's water demands will approach the limits of projected available water supply
- Current use for the Metropolitan North Georgia Water Planning District is 652 MGD; by 2030 it will exceed 1,200 MGD

How does Atlanta Use its Water?



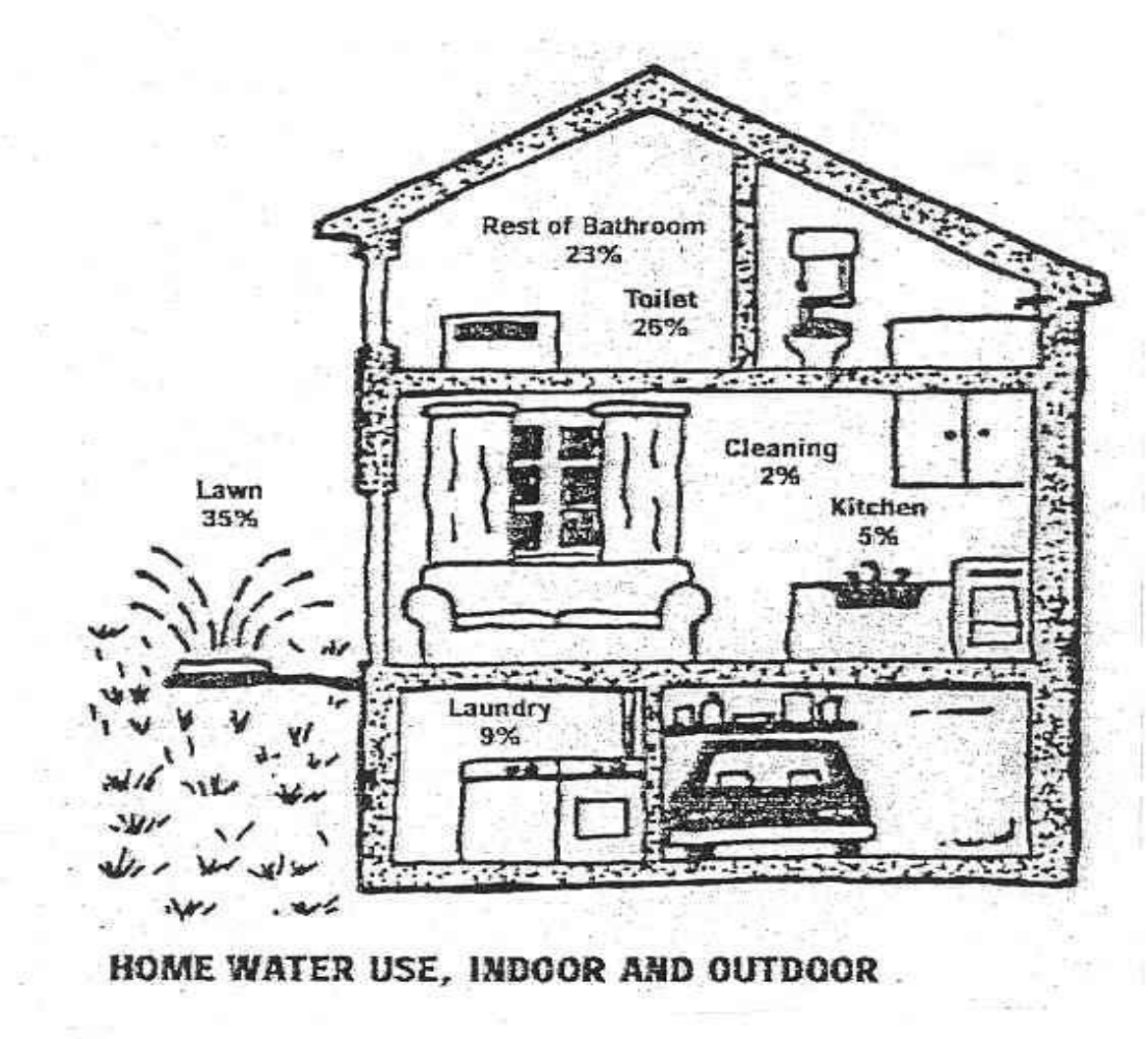
Surface Water Supply Problems

- Non Point Source Pollution
  - Turf fertilizers/pesticides from lawns and golf courses
  - Storm water runoff from impervious surfaces (parking lots, roofs, roadways, etc...)
- Man-Made Reservoirs
  - Siltation
  - Change of end use designation from supply to recreation
  - Alabama, Florida, Georgia Water Wars
- Development of a water shed leads to increasing run-off and decreasing ground water movement and storage

'Typical' Household Consumption

- 60 percent of total domestic potable use can be substituted with non-potable water
- 46 percent of domestic potable water consumption is used for irrigation
- 16 percent of fresh water is used for flushing toilets

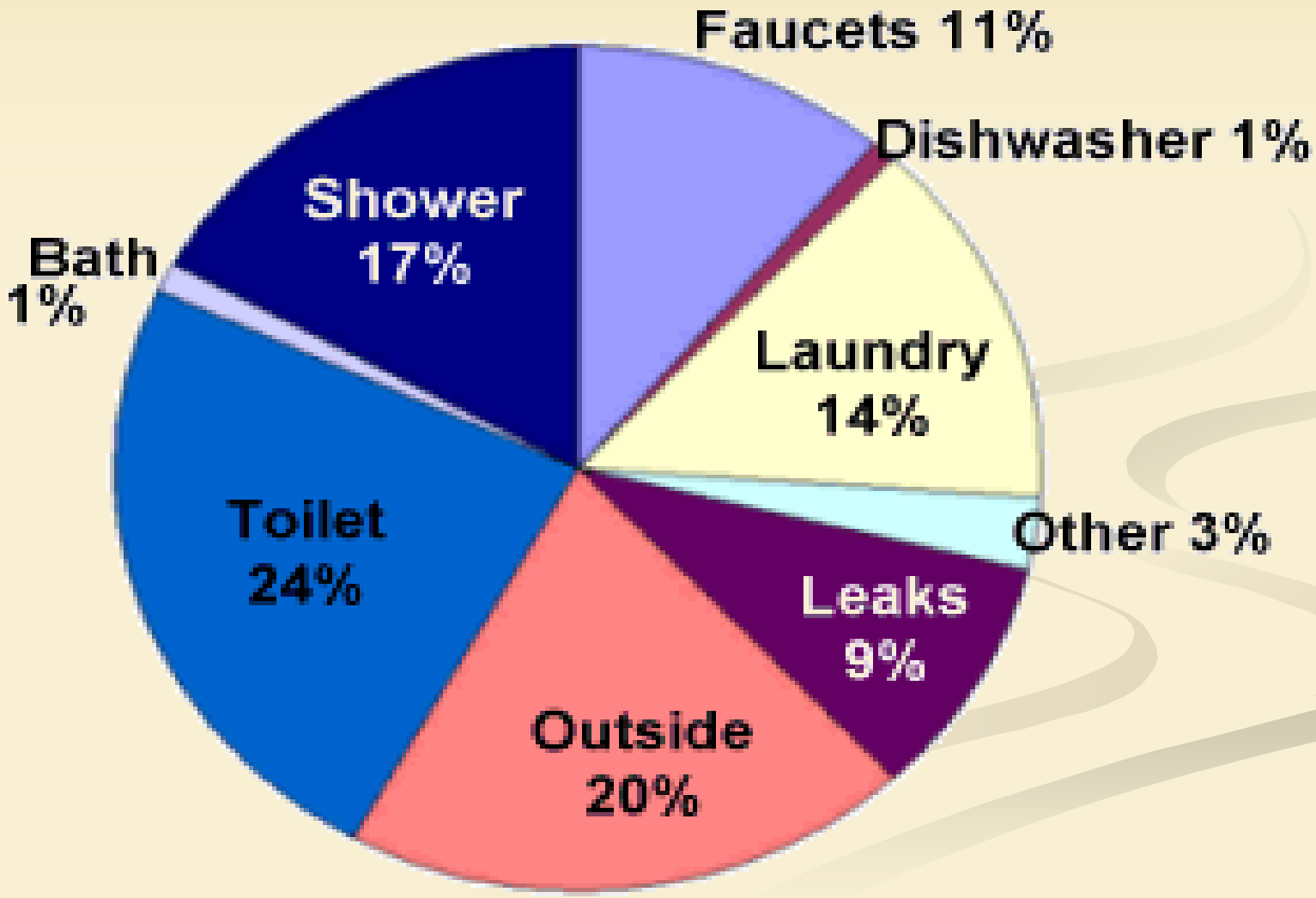
Typical Home H2O Consumption



Per Capita Consumption

- 150-175 GPD in the Metro Atlanta area
- Compound Problem
  - Majority of fresh water supply for metro Atlanta is surface water
  - Population growth in metro area will continue; demand for fresh water will surpass (2030) current available supplies of fresh water; therefore, population growth will be limited which leads to economic impact.

Per Capita Consumption



The Dilemma

- economic growth is directly related to population growth
- 0 Population Growth = 0 Economic Growth
- WITHIN THE NEXT 20 YEARS, **Atlanta**
  - will have to reduce their per capita consumption by 50 percent, or
  - have to increase our supplies by 200 percent

What is this Economic Impact?

- Reduced housing starts
- Reduced retail expansion
- Reduced corporate relocation and expansion
- Reduced quality of life
  - outdoor recreation opportunities will be limited (water parks, public pools)
  - landscaping will be limited
  - irrigation will be restricted

Are There Solutions?

- Conservation
  - Water frugal appliances and devices
  - Living Walls and Garden Roofs
- Re-Use and Reclamation
  - Rain water collection
  - Gray water re-use
  - Constructed wetlands
- Increase Access to Resources
  - Well drilling
  - Desalination
  - Increase reservoir capacities
  - Increase surface water collection (rivers)

We must have a Paradigm Shift

- Americans are currently a **consumers** focused on the exploitation of natural resources for short term capital gain without regards to the long term ramifications.
- The continuance of this behavior will deplete our resources without conserving for future generations.
- Therefore, we must become **conservationists** (not preservationists)

What Road Do We Choose?

- Conservation
  Adjust Lifestyle
  - Re-Use
  - Harvest Rain and Dew
  - Conserve
- Consumption
  Status Quo
  - Drill wells
  - Desalinate
  - Increase surface withdraws
  - Mine aquifers

Conservation Driven Solutions

- Look at other municipalities for examples:
  - Austin, TX leads the way
    - Toilet Exchange
    - Rain Water Collection Rebates
    - Xeriscaping Subsidies
  - Tucson, AZ
    - Rain Water Collection required at all new homes
  - Water Re-Use Opportunities in CA, NM, AZ, etc...
    - Graywater Ordinances (IPC Appendix C)

Re-Use

Recycling previously used non-septic water for non-potable end uses. This may be termed **Graywater**

Non-Septic Sources

Laundry

Showers

Baths

Some Lavatories

Septic Used Water

Toilets

Kitchen water

Reclaimed Water

- Collecting and treating previously used water for potable and non-potable end use
  - Rain Water
  - HVAC condensate
  - Dew collection

Resource Access

- Construct new reservoirs
- Gain access to previously un-used resources
  - Tennessee River
  - De-salination
  - Deep Wells
- New Technologies
  - Dew Collection
  - Constructed Wetlands

Grey Water

- Used Primarily for Subsurface Irrigation of Ornamentals and Turf and Sewage Conveyance
- Typical Per Capita Production: 60-75 gpd
- Benefits
  - Decrease waste stream from home
  - Decrease amount of fresh water purchased (reduced withdrawals)
  - Unlimited supply of irrigation water
- Requirements
  - Low phosphate, low boron and chlorine free laundry soaps required
  - Maintenance of filters required

Truly Sustainable

- sustainable source of non-potable water

Laundromat: Front Loader 15 gals. per wash
Top Loading 35 gals. per wash
Shower: 2.2 gals per minute (or more)

Water ReUse System

- Components
  - Dual Drain Plumbing (bathrooms and laundry)
  - Dosing Tank
  - Filtration
    - Preliminary: removal of large particles at entrance to tank
    - Secondary: 200 mesh screen at irrigation valve in distribution system
  - Pumping System
  - Distribution System (Sub-Surface Irrigation)
    - Netafim Bioline

Greywater Recovery

dual plumbing for drain system required

500 gallon Dosing Tank

Dosing Tank:

Receives the gray water from the building from which it is pumped into the landscape

500 gallon Dosing Tank

- Spherical dosing tanks can be installed in smaller areas due to a smaller footprint – only 55" diameter

Primary Filtration of Gray Water

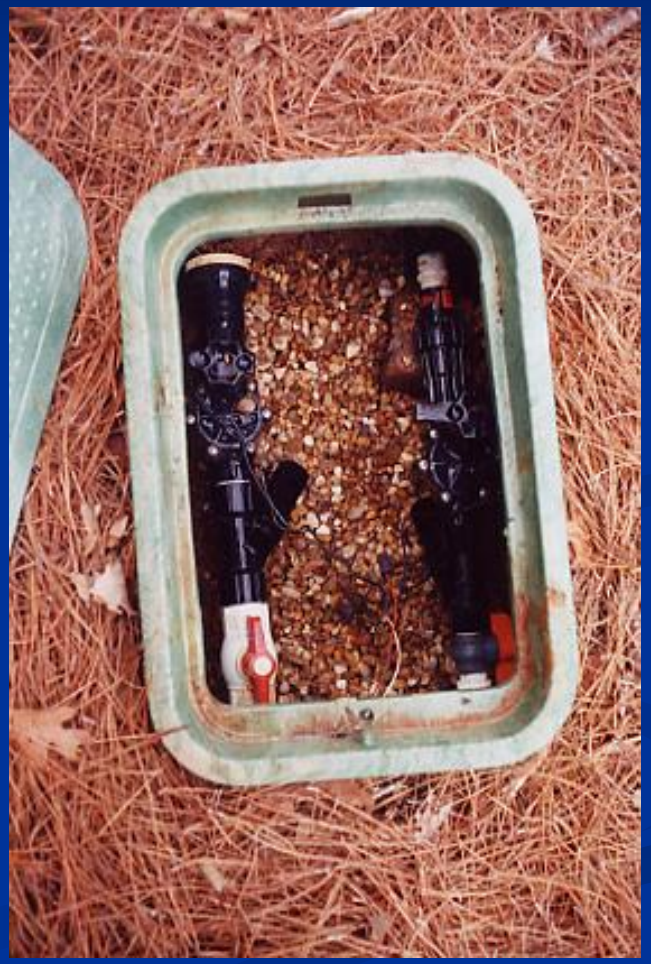
- Pre-filtration of water at inflow to 500 gal. dosing tank
- Disposable bags
- Removes hair, lint and other debris.

Secondary Filtration of Gray Water

- 200 mesh disc filter
- Removes fine particulates and sediment.

Tertriary Greywater Filtration

- 120 mesh (140u) filter at each zone of the sub-surface irrigation system
- Eliminates any potential debris to obstruct emitters



Tandem Pump System

- Primary pump and secondary pump for periodic excessive use or primary pump failure

Single Pump System

- Pump should handle dirty water and move 10-12 gpm
- Notice the level sensor

Distribution of Grey Water

- Distribution through the Netafim Bioline
- Bioline surrounded by engineered soil high in organic material
- Lines distribute water at 4-8 gph at 30 psi
- Emitters are spaced 18" on center
  - This will vary depending on soil type

Sub-Soil Preparation

- Some sites require the B Horizon of the soil to be prepared so that gray water absorption is maximized

Cost of Water ReUse

- Variables Which Determine Cost
  - Size of the Absorption Field
  - Amount of gray water generated within the facility/residence will determine cost
  - Soil Type
    - Amending the soil may be necessary
    - Loam-clay offer the best absorption capabilities
  - Retofit or New Construction (extensive remodel)

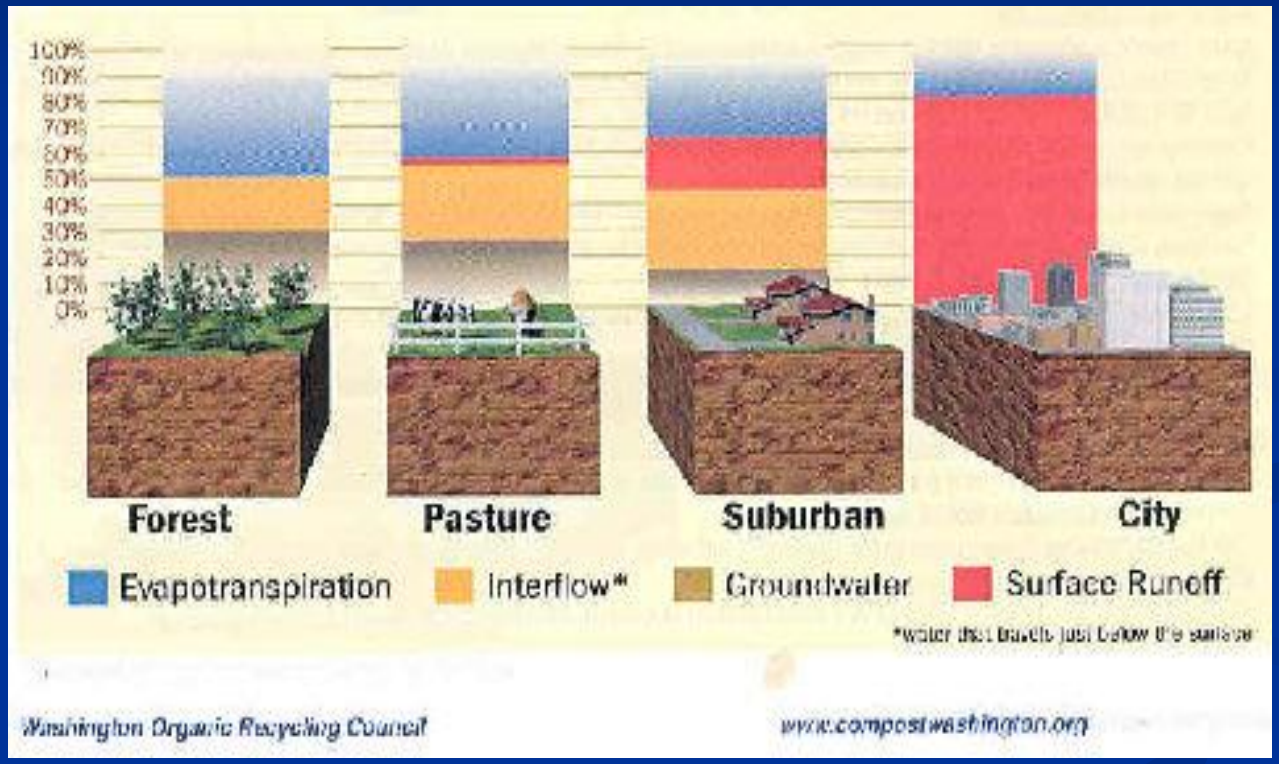
HOW MUCH?

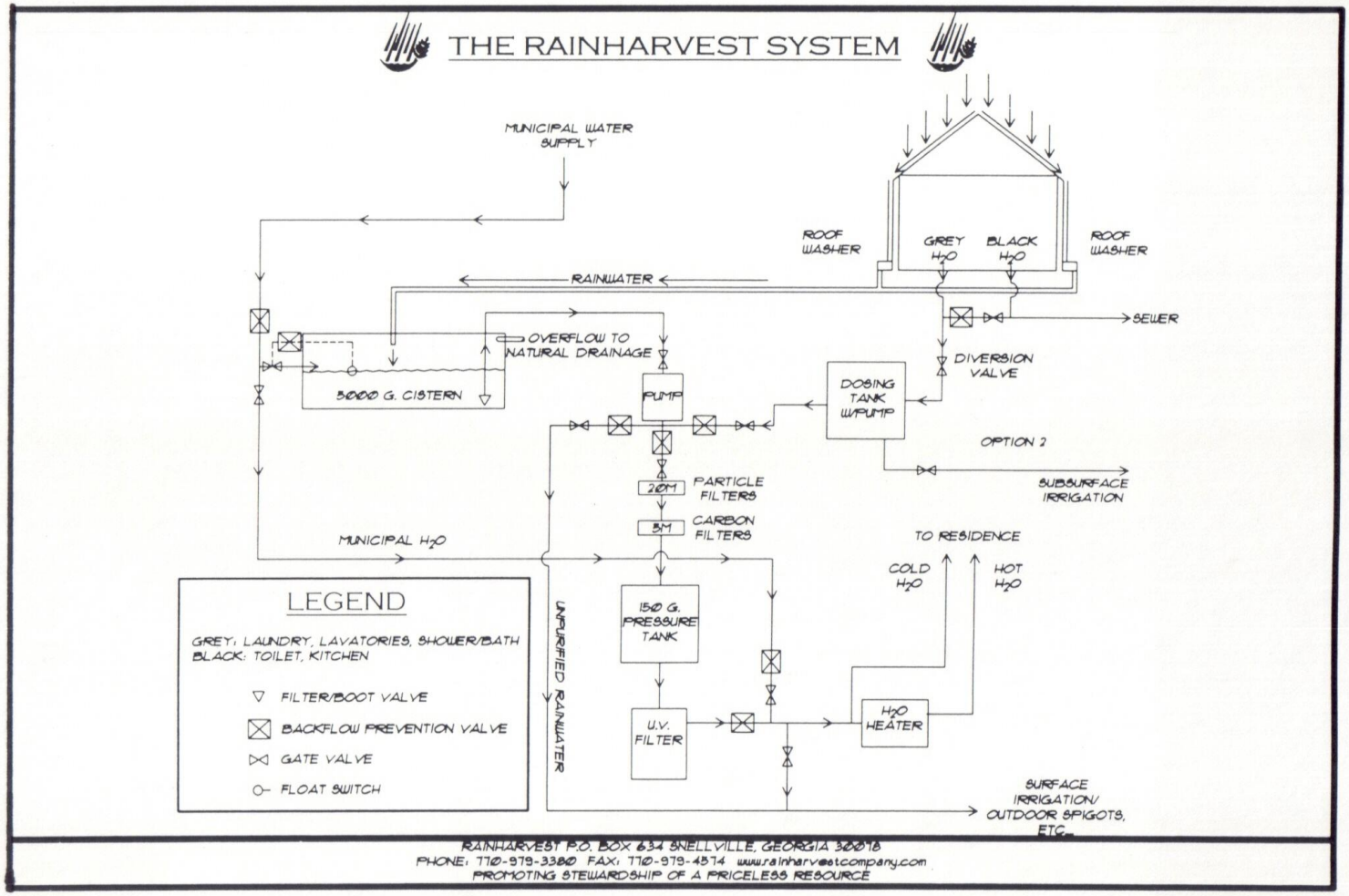
- 'Typical' 4 bedroom, 3.5 bath residence with 4 occupants will cost $6000 - $8000
- Small Office/Work facility, 10-15 employees, will begin around $12000

The RainHarvest System

- Collect rain water from the roofs, patios, driveways and any impervious surface as well as HVAC condensate.

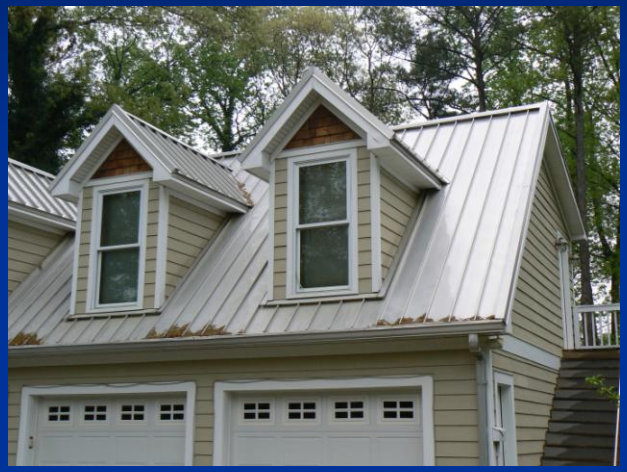
Manmade Hydrological Cycle




THE RAINHARVEST SYSTEM
MUNICIPAL WATER SUPPLY
ROOF WASHER
GREY H_2O
BLACK H_2O
ROOF WASHER
RAINWATER
SEWER
OVERFLOW TO NATURAL DRAINAGE
5000 G. CISTERN
PUMP
DOSING TANK W/PUMP
DIVERSION VALVE
OPTION 2
SUBSURFACE IRRIGATION
20M
PARTICLE FILTERS
5M
CARBON FILTERS
MUNICIPAL H_2O
TO RESIDENCE
COLD H_2O
HOT H_2O
150 G. PRESSURE TANK
UNPURIFIED RAINWATER
U.V. FILTER
H_2O HEATER
SURFACE IRRIGATION/ OUTDOOR SPIGOTS, ETC.
LEGEND
GREY: LAUNDRY, LAVATORIES, SHOWER/BATH
BLACK: TOILET, KITCHEN
FILTER/BOOT VALVE
BACKFLOW PREVENTION VALVE
GATE VALVE
FLOAT SWITCH
RAINHARVEST P.O. BOX 634 SNELLVILLE, GEORGIA 30078
PHONE: 770-979-3380 FAX: 770-979-4574 www.rainharvestcompany.com
PROMOTING STEWARDSHIP OF A PRICELESS RESOURCE


Irrigated with
RECLAIMED
RAIN WATER
with The RainHarvest System
RAINHARVEST
COMPANY
www.rainharvestcompany.com

How Much H_2O?



- 1000 sq. ft. surface X 1.00" rainfall

=660 gallons!

Components of the System

- Collection System
  - Gutters, catch basins via SDR35 PVC piping
- Storage System
  - Storage for 30 day drought or longer.
    - Cisterns: Below Ground, Above Ground, Open
    - Rain Tank
    - Storm Tech System
  - Dependent on amount of water required in the residence, business or by the landscape
- Distribution System
  - irrigation
  - plumbing

Different Roof Materials

Collection System

- SDR 35 PVC pipe or SCH 40 PVC
- Solvent Weld Joints up to 6”
- 8” and above use gasket fittings
- 4” and above use primer

Rain Water Storage

- Above Ground Cisterns
- Below Ground Cisterns
- Alternative Storage Systems
  - Open Cisterns
  - StormTech
  - RainTank

Storm Tech System

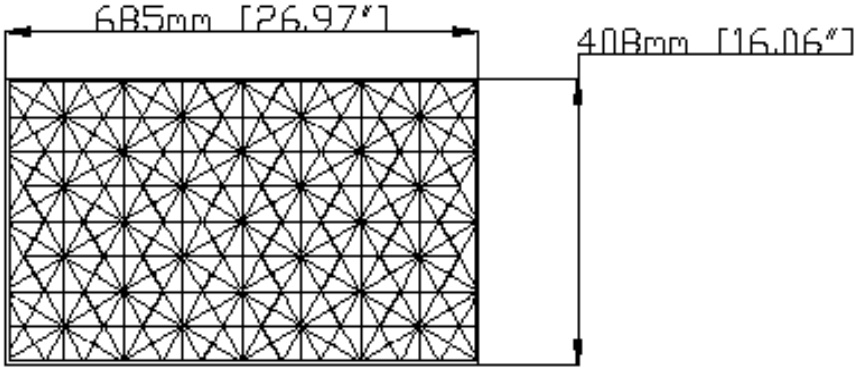
- Storm water detained for percolation into the soil through geo-textile
- Re-Use by retaining storm water within 40 mil. EPDM liner.

12,000 gallons capacity
$1.33 per gallon

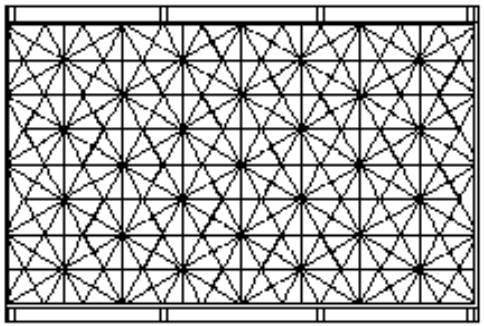
Southface Eco Office, Atlanta, GA
Rain Tank

- The Atlantis Raintank can be used for residential or commercial applications. This tank stores over 15000 gallons.
- Post-consumer plastic
- Assembled on-site
- www.atlantiscorp.com.au

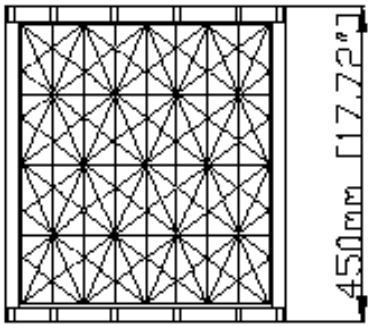
14,000 gallons capacity
$1.21 per gallon



Plan View



Side View



Front View

Drawing No: AOP 0024

Atlantis® Water Management for Life

Atlantis® Matrix® Single Tank Module

Part No. 70003 – (W)408mm [16.06"]x (L)685mm [26.97"] x (H)450mm [17.72"]

Maximum Recommended Load = 26.5t/m^2 [37.6 psi]

Volume = 125l [33.02 US gallons]

8 Modules = $1m^3$

Open Cisterns

- This contains 500,000 gallons.
- Less expensive than closed storage below ground.
- Susceptible to contamination and vandalism
- Consumes usable space

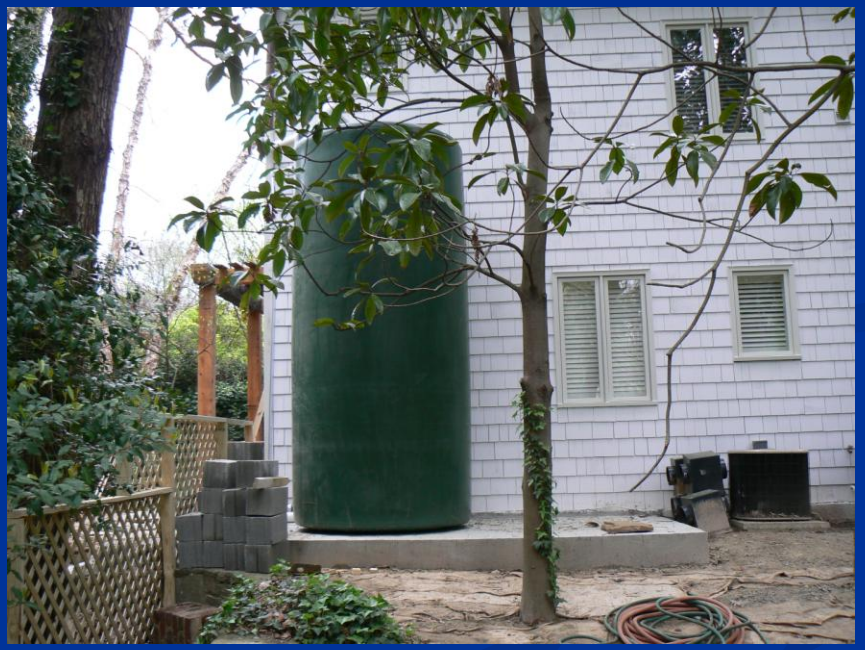
Above Ground Cisterns (AGC)

- Advantages
  - Least expensive to install
  - Routine visual inspection easy
- Disadvantages
  - Visually obvious
  - Must allocate space
  - Limited water harvesting capacity

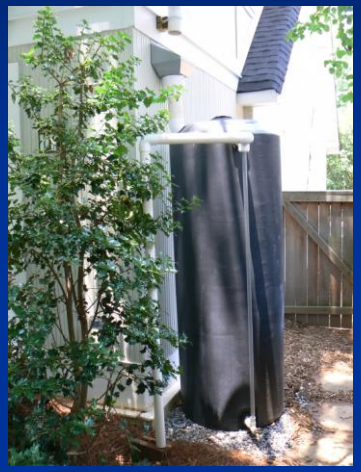
3000 – 5000 Gallon Capacity

Various Sizes Above Ground Cisterns

More AGC.



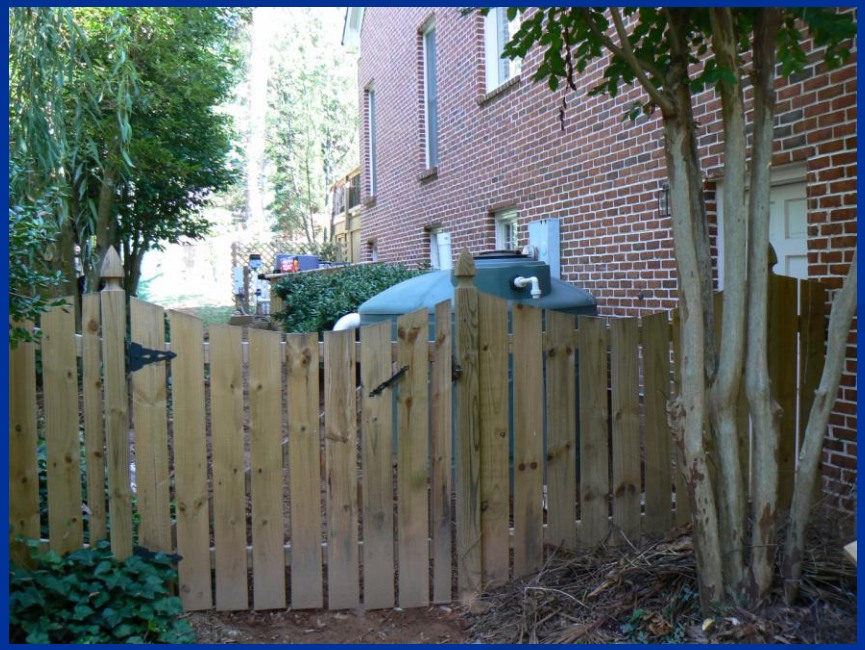
Residential AGC Applications



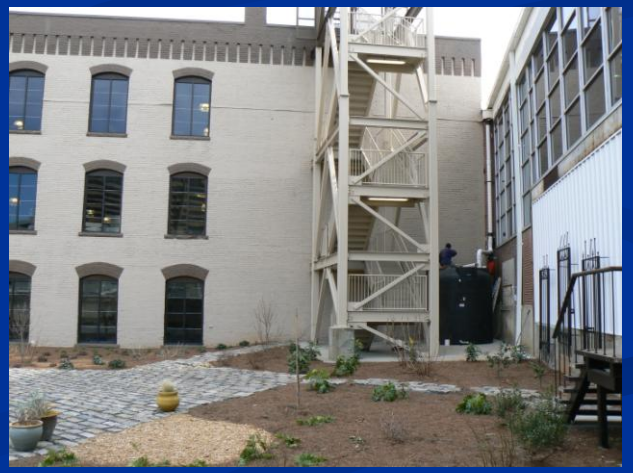
Trees Atlanta
Corporate Office Atlanta

3000 Gallons Residential

1600 Gallon Residential



City of Atlanta Department Watershed Management 5000 Gallons



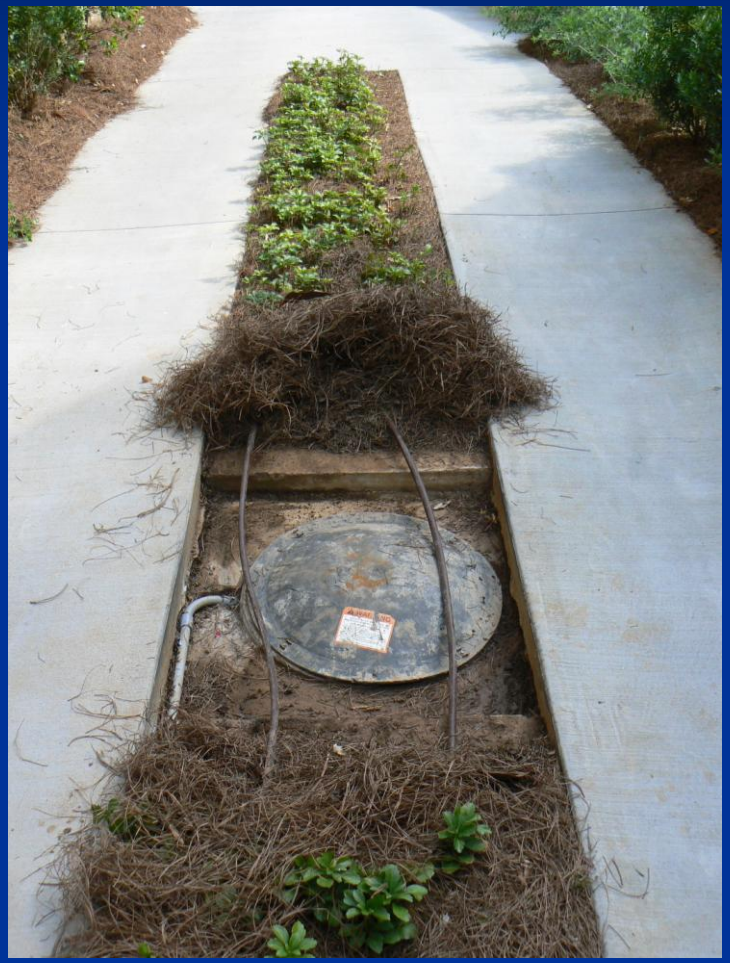
2400 gallon cistern creatively hidden in un-used space below a deck

200 gallon cisterns hidden within the architecture of the structure of the residence.

55 gallon Rain Barrels

- inexpensive
- easy to install
- minimal pressure
- minimal capacity

Innovative Installations



Below Ground Cisterns (BGC)

- Advantages:
  - Hidden from view
  - Efficient use of space
  - Protected
  - Collect the most water
- Disadvantages
  - Expensive compared to AGC
  - Invasive installation on retrofits

1700 Gallon capacity
Snyder, Rotonics, Norwesco, Fralo, Bushman (Au)

Tandem Installations

EcoManor, Atlanta, GA
Cisterns installed below driveway

1700 Gallon installed below proposed deck next to concrete driveway

3400 Gallon capacity is most common residential application

6800 Gallon Capacity

Components of the System

- Filtration/Purification System
  - Determined by End-Use
    1. **Standard for All End-Uses**: sediment and debris minimization
       1. Gutter protection
       2. Roof Washer
       3. Pre-Filter
    2. **Potable End Use:** requires filtration and purification
       1. 50u is primary stage; 05u is secondary stage
       2. Purification and Enhancement (UV or Chlorine)
    3. **Irrigation End-Use**: requires filtration only
       1. 200u

Water Treatment Methods

Primary Filtration – Roof Washer

- Roof Washers are the most common and dependable system for removal of roof debris prior to the cistern.

Bio-Filtration

- Benefits
  - Aesthetics
  - Plant roots help to retain, if not enhance, filtration or infiltration rates especially in clay soils.
  - Vegetation increases water-quantity reduction by evapotranspiration
  - Reduction in temperature of discharged water (trout streams)
  - Vegetation captures incoming sediment
  - Plants contribute organic matter that absorbs metals, pesticides, petroleum, polycyclic aromatic hydrocarbons, pathogenic bacteria and viruses and nitrogen
- Concerns
  - Minimize turf grasses that may require fertilizers and maintenance
  - Favor deep rooted plants over turf grasses

Bio-Filtration Layers

- 40 mil EPDM membrane containment
- Non-woven fabric on top
- Recycled concrete
- Non-woven fabric on bottom

- Notice root barrier around perimeter of system.

Primary Filtration –Basket Filter

Primary Filtration – Leaf Grabber

- Removal of roof debris is essential to keep cistern clean

Secondary Filtration

- Removes odor, chemicals, lead, arsenic and bacteria.
  - De-acidification
  - Chlorination and De-chlorination
  - Solid Carbon Block or Granulated Carbon
  - Enhancement

Components of the System

- Purification for Potable End-Use (including toilet flushing)
  - UV – should be NSF rated
  - Reverse Osmosis
  - Chlorination
  - Enhancement with minerals

Pump/Purification System

Normally located in basement or other convenient location for easy access, monitoring and maintenance

Purification

- Rain water used for potable end use must be purified following filtration. This would involve UV sterilization and/or chlorination.

Water Enhancement

- Rain water used for potable end use can be enhanced with minerals and fluoride.

Pumping Systems

- Centrifugal pump by Davey. Normally 12 gpm at 40 psi

- 4" Submersible pump by Franklin. Normally 20 gpm at 35-40 psi

Components of the System

- Distribution System
  - Irrigation (minimal filtration – 200u)
    - Micro Spray for bedding plants; groundcovers
    - Netafim Drip for ornamentals
    - MP Rotators for turf
  - Domestic Plumbing (NSF rating filtration and purification)
  - Other (filtration methods vary)
    - Water Features
    - Fire Suppression

Irrigation with Rain Water

- Must be low flow/low gallon usage: Drip, Micro-spray, MP Rotators
  - gallons per hour (gph)
  - Proper Pressure = 40 psi max.
- Detailed Hydrozones
  - Lawn
  - Shrubs
  - Perennials
  - Seasonal color
  - Shade
  - Sun
  - Hill
  - Level

Automation and Data Collection

- Transmits water level information to computer or digital screen.
- Enables solenoid valves to switch between alternative water sources (well, municipal, rain)

HVAC Condensate Collection

- Easy water to add into drain leaders
- Distilled water

Condensation Collection

- 15 gallons per day per ton of HVAC
- Typical 3 ton unit will yield 45 gallons per day.
- Allow drain lines to be inspected periodically for algae growth.

Variables which Determine Cost

- Amount and Type of storage (cistern size and location): Above Ground or Below Ground Cistern
- Size of Irrigation System: # Hydrozones
- Intensity of Filtration and/or Purification
  - 200u for irrigation
  - 5u for UV
  - UlraViolet
  - Reverse Osmosis
- Difficulty of Cistern Installation

The Cost of a RainHarvest System

- 'Typical' 4000 sf. residence will cost $8500 through $12500 without automation
- Automation usually adds $2500 or more to the cost

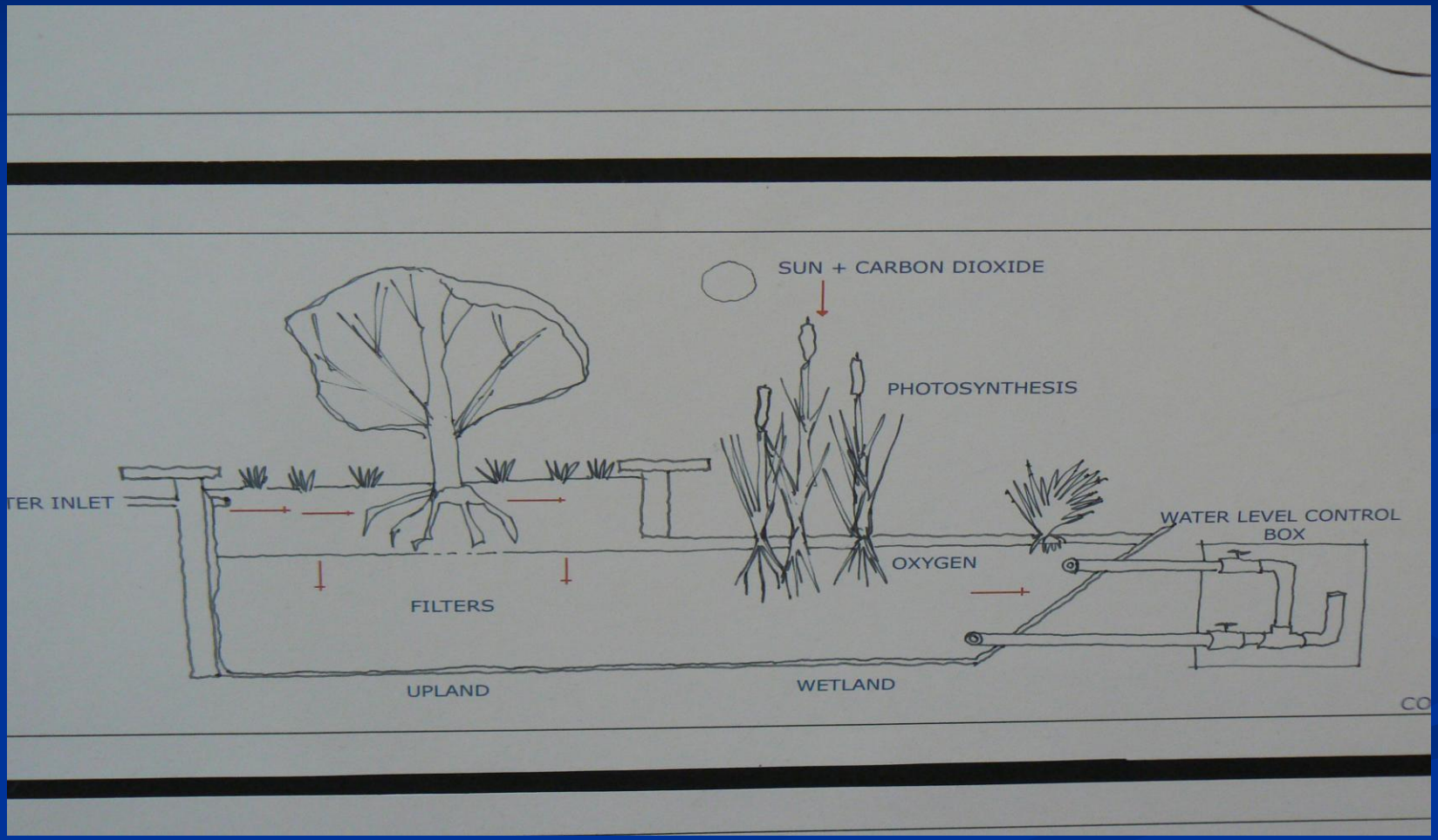
When the well's dry, we know the worth of water." –

Benjamin Franklin

What are Constructed Wetlands?

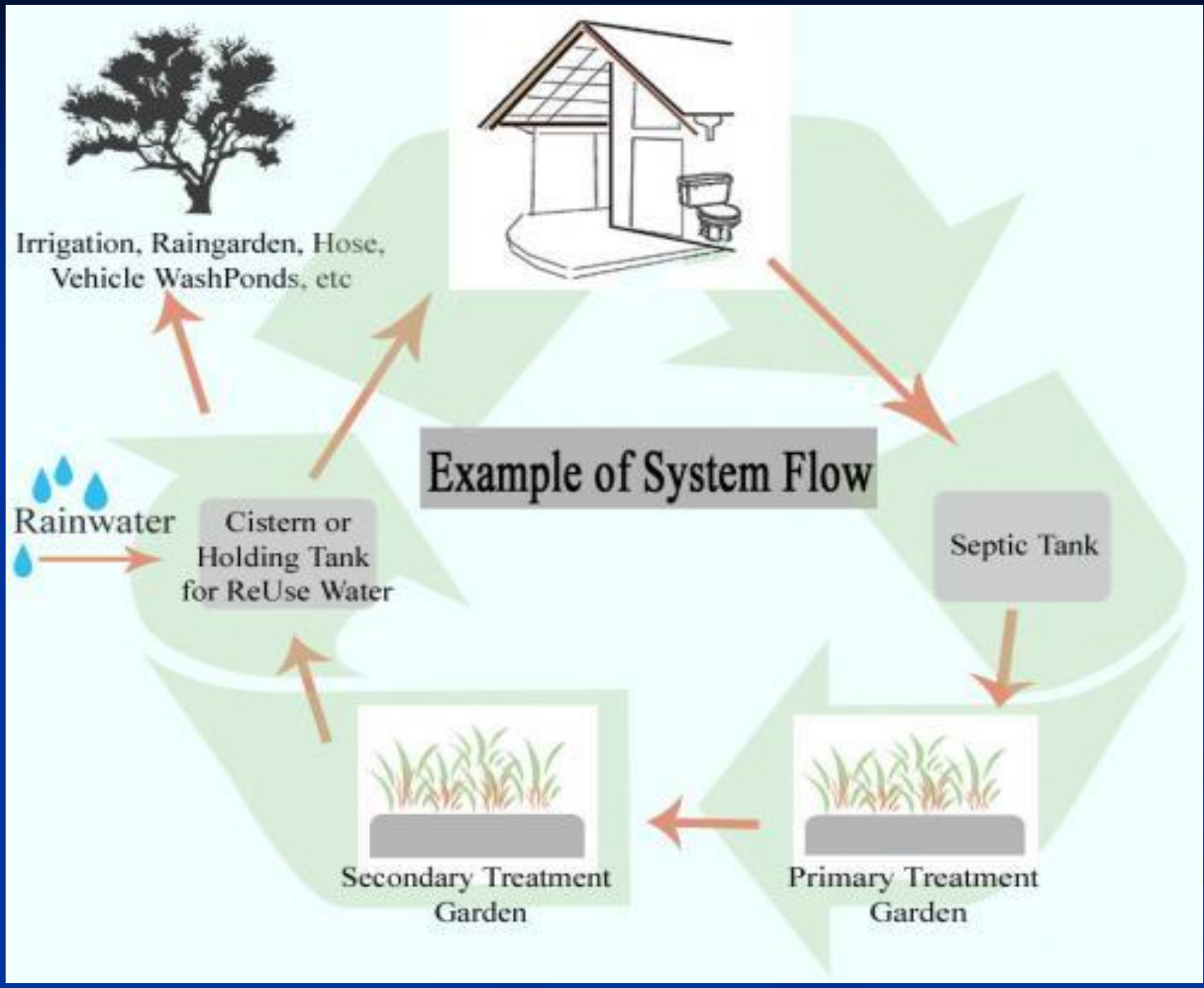
- A built system which uses bio-mimicry to filter and purify waste water to tertiary standards.
- Suitable for toilet flushing and spray irrigation.

Cross Section of Sub-Surface Flow Constructed Wetlands



Constructed Wetlands

courtesy of IWS, Raleigh, NC


Irrigation, Raingarden, Hose,
Vehicle WashPonds, etc
Example of System Flow
Rainwater
Cistern or
Holding Tank
for ReUse Water
Septic Tank
Secondary Treatment
Garden
Primary Treatment
Garden

- "Socialism collapsed because it did not allow prices to tell the economic truth. Capitalism will fail because it does not let prices tell the ecological truth." ~

- Oystein Dahle, VP, Esso

Irrigation Systems

- Proper Stewardship dictates certain Principles
  - Reclaimed water not drinking water
  - Low Volume consumption (gallons per hour)
  - Placement of Water at or directly above root zone
  - Technology
  - Pressure Regulation – maximum 50 psi
  - Check Valves on all spray heads
  - Mutiple Hydrozones

Irrigation Goals

- Deliver the correct quantity of water required by each individual plant so it may grow in a viable and healthy manner.

HOW?

- Replace the amount of water lost through Et on some regular basis

Common Mistake

- It is common to apply 1.00” of water on the entire landscape regardless of the plant species. However, while 1.00” of rain is normal for indigenous plant species, when exotics are introduced, the irrigation requirements become more complex.

Irrigation Don'ts

- Don’t over-water
  - Runoff
  - Root rot
  - Soggy/Rotten soil
  - Oxygen starved soil
- Don’t under-water
  - Drought stress
  - Stressed micro-organisms

Irrigation Do's

- Add the proper amount of water:
  - Know what the plant requirements are:

    Gallons = (Et x plant factor) x A x 7.48

  Know what the Precipitation Rate (PR) of the emitters are: gallons per minute (GPH) or gallons per hour (GPH)
  - Calculate how long to water
- Hydrozone

The Et Rate

- What is Et?
- Evapo - transpiration
  - Evaporation from the ground
  - Transpiration from the plant leaves and bark
- Measured in inches per day
- Data available from NOAA
- WWW.GEORGIAWEATHER.NET

Rainfall

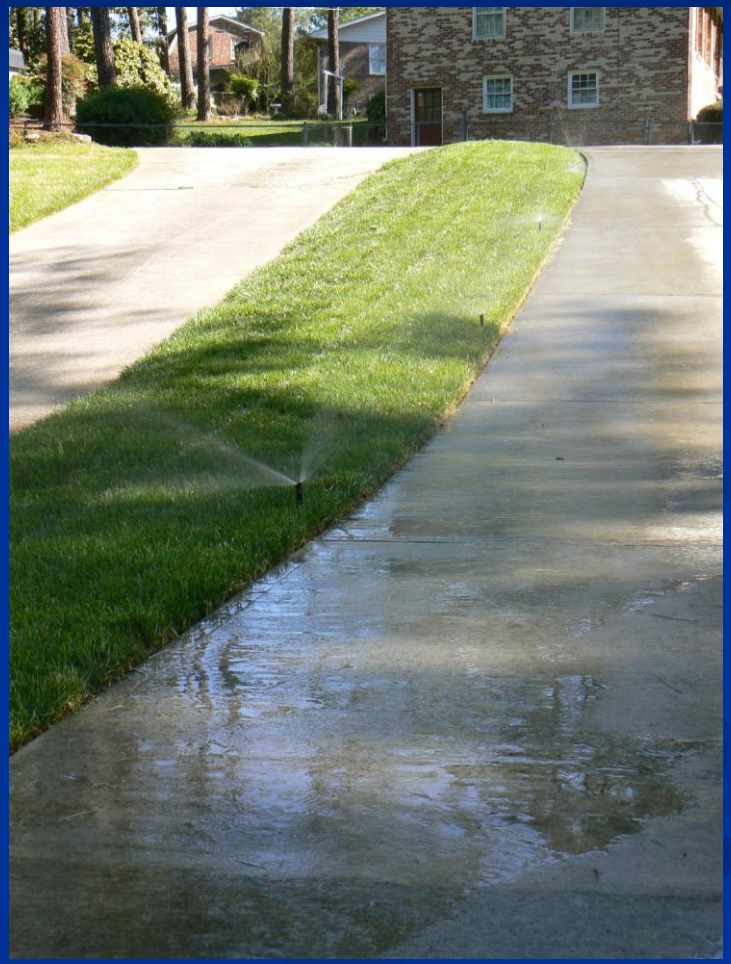
- 1.0” rain over 1 acre = 27,154 gallons
- Normal North Georgia rainfall
  - 51.00 inches per year or approximately 1.0” per week
- Common mistake is to apply 1.00” of water over the entire landscape regardless of plant species.

Common Irrigation Problems

- Maximum efficient operating pressure 70 psi
- Preferred operating pressure 55 psi
- Too much pressure results in misting, drift and pre-mature wear of hardware

Common Irrigation Problems

- Should be two zones
- Improperly aimed
- Too much pressure – too much drift
- Excessive ‘run time’



Common Irrigation Problems

- Many irrigation systems operate before dawn.

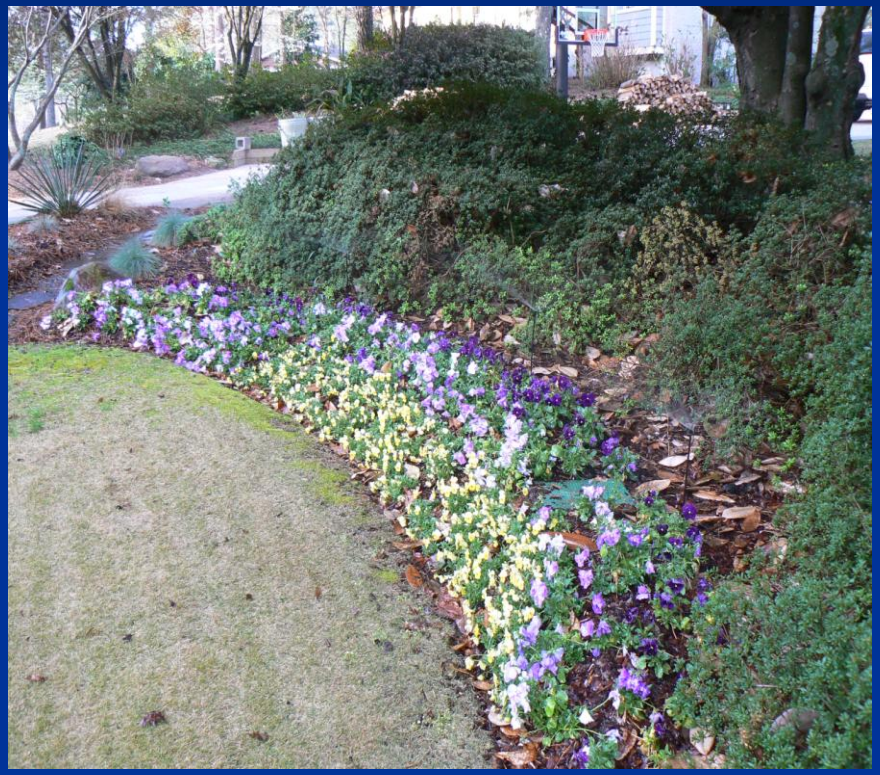
Who sees the leaks?

0.5 gpm x 15 mins. = 7.5 g.

Hydrozoning

- Consider:
  - Solar exposure – sun, shade, partial
  - Topography – slope, level, bottom versus top of hill
  - Plant Type – shrubbery, trees, turf, perennial, seasonal color
  - Soil type – sand, loam, clay

Hydrozones



- Three Distinct waterirg regimes required here:
  - Seasonal color
  - Turf
  - Shrubbery
  - Mature Trees

Hydrozoning

- 4 distinct zones in this yard
  - Seasonal color
  - Groundcover
  - Turf
  - Shrubbery

Hydrozones

- Consider the slope and solar exposure
- Consider shrubbery versus perennials

Efficient Distribution

- Micro-Spray
  - Perennials, seasonal color, groundcovers
- MP Rotators
  - Turf areas, large groundcover areas
- Drip
  - Surface for shrubs, trees
  - Sub-surface for turf, non-potable water

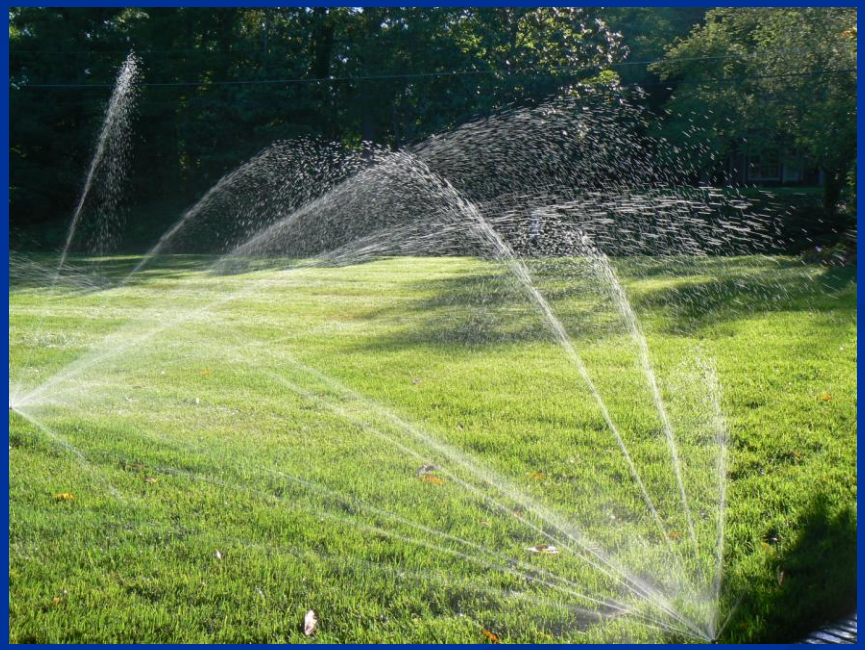
Micro Spray Irrigation

- adjustable flow
- efficient
- minimal misting,
- very little evaporation
- no run-off

MP Rotators

- MP Rotators by Hunter
- no misting
- pressure compensating
- efficient
- precise arc and pattern control
- matched precipitation

MP Rotators



Surface Drip

- no evaporation
- most efficient use of water
- minimal excavation
- no run-off
- minimizes disease
- minimizes weeds
- Netafim or Rainbird

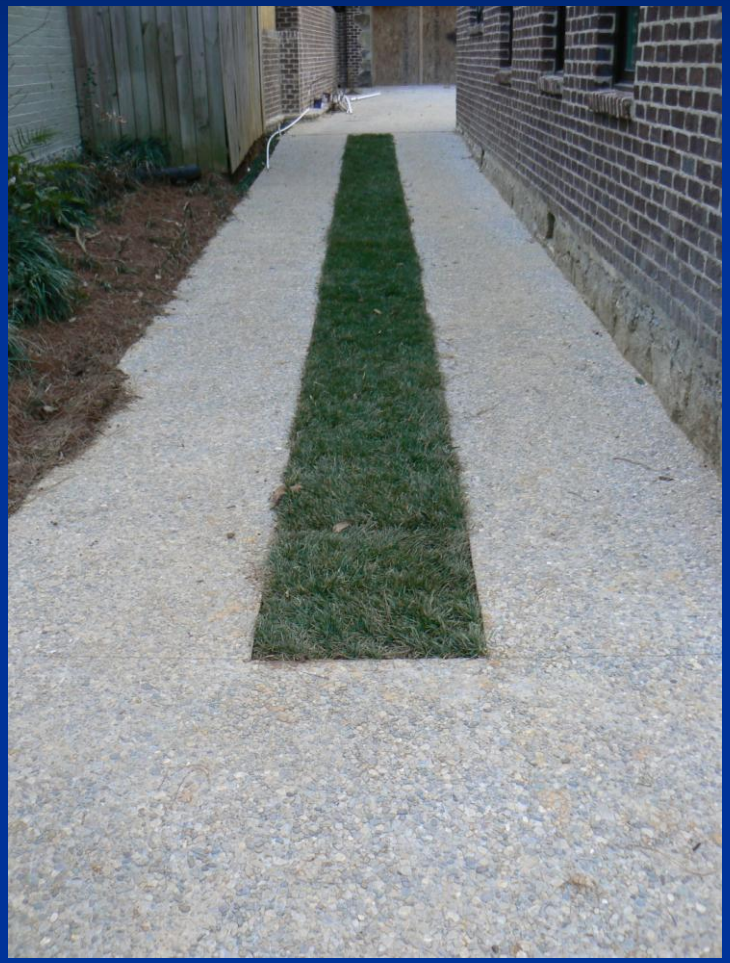
Surface Drip

- Application of water directly to root zone
- Below mulch for moisture retention
- Position drip line for even distribution of water
- Choose emitter according to the mature size and requirements of the plant

Inline Surface Drip Emitter

0.4, 0.6, 0.9 gph

Creative Irrigation Techniques
Subsurface Drip



Irrigation Technology

- Smart Controllers
- Two Wire Systems
- Soil Moisture Sensors
- On-site Weather Monitors
  - Rain Sensors
  - Wind Sensors
  - Freeze Sensors
  - Et (evapotranspiration)

Mechanical Controllers

- mechanical, fail safe, traditional
- easy to operate
- maximum guess work without knowledge of programming

Smart Digital Controller Systems

- **TWO TYPES**
  - daily operations of the system based on current NOAA information
  - on site weather station
- input parameters
- hydrozoning imperative
- after programmed, no human involvement required for continuous operation
- Weathermatic SL1600
- HydroPoint
- Toro
- Calsense


PGM
NEXT
BACK
RUN MANUAL PROGRAM
SUN MON TUE WED THU FRI SAT
3:11PM
ADJUST VALUE
MODE
AUTO ADJUST
STANDARD
ACTIVE
BYPASS
SENSOR
RUN
MANUAL ZONE
SYSTEM OFF
MANUAL TEST
SET TIME / DATE
SET ZONE RUN TIMES
SET DAILY START TIMES
SET WATERING DAYS
SET OMIT TIMES/DAYS
SEASONAL % ADJUST
AUTO ADJUST
MORE/LESS
SOIL TYPE
PLANT TYPE
SPRINKLER TYPE
ZIP CODE / LATITUDE
ADVANCED FUNCTIONS
Weathermatic
SMARTLINE

On-Site Weather Monitors

- precise weather information
- information collected and relayed to the controller:
  - wind
  - rain
  - temperature
  - Et

Our Professional Responsibility

- We have the ability to encourage change -
  - we are trusted by the client
  - we are in the public forum
  - we are contracted to design and plan
  - our work impacts the social, economic and environmental aspects of our community first and ultimately, the world.

As architects, engineers, planners, designers and policy makers we can encourage the paradigm shift of behavior.

Recommended Reading

- Blue Gold
  - Maude Barlow and Tony Clarke, 2002, The New Press, New York

Can We Prevent This?

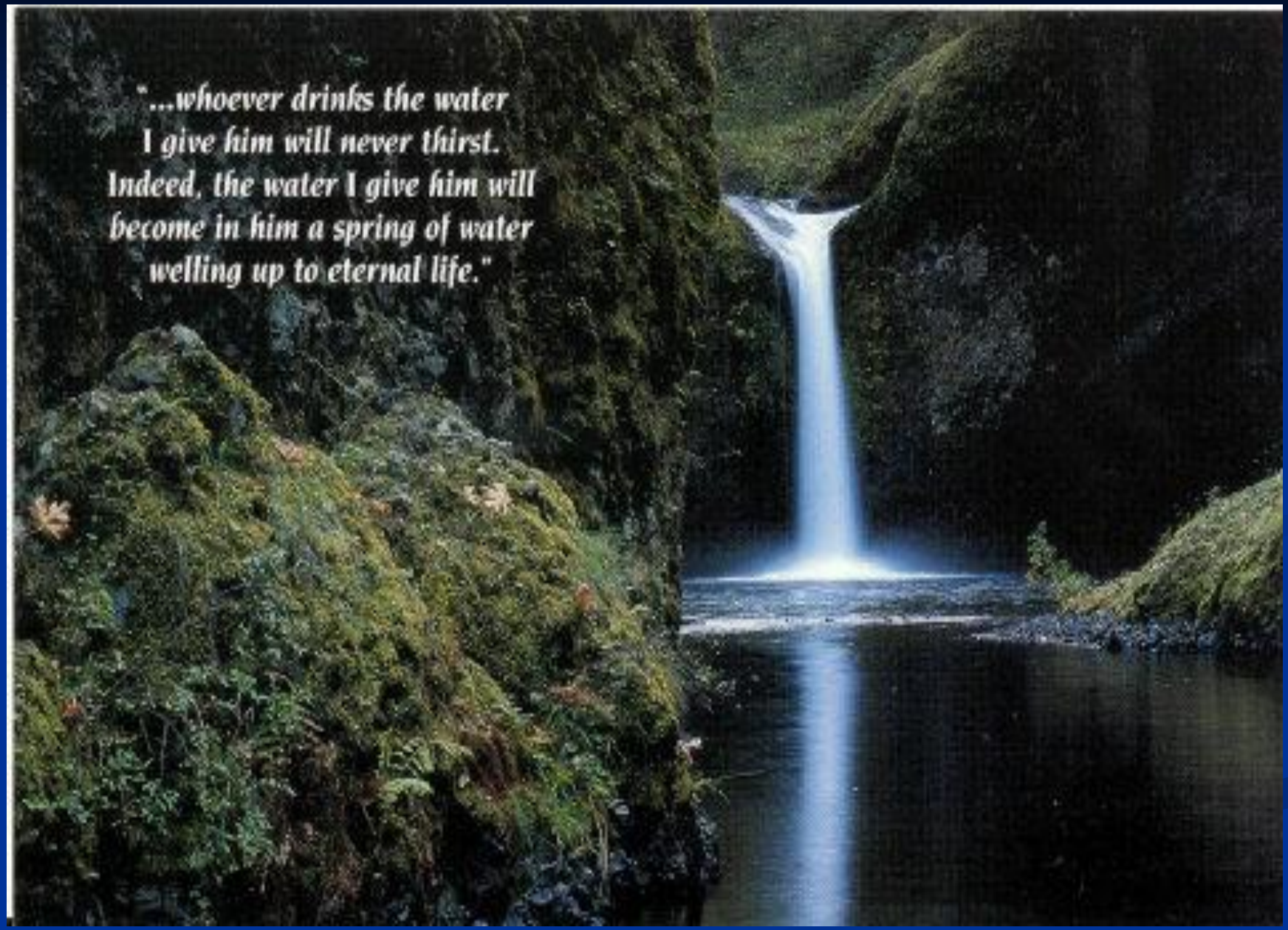
The RainHarvest Company

- Established in 2000 for the purpose of "Promoting the Proper Stewardship of a Priceless Resource"
- Although our most popular products are The RainHarvest System and The Water ReUse System, our primary product is to offer sustainable **water management strategies** to residential, commercial and institutional clients by encouraging conservation, reuse, and recycling.
- We enable our clients to be proper stewards of water by managing their consumption to absolutely minimize municipal water purchases and maximize efficient use, re-use and recycling of their indigenous water supply.

The RainHarvest Company

- www.rainharvestcompany.com
- Voice 770.652.0160 Fax 770.979.4574
- pmorgan@rainharvestcompany.com

Promoting the Proper Stewardship of a Priceless Resource Since 2000


"...whoever drinks the water
I give him will never thirst.
Indeed, the water I give him will
become in him a spring of water
welling up to eternal life."

Thank You!